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AMMRC AUTOMATED STRESS-STRAIN DATA ANALYSIS, STORAGE, AND RETRI--ETC(U)
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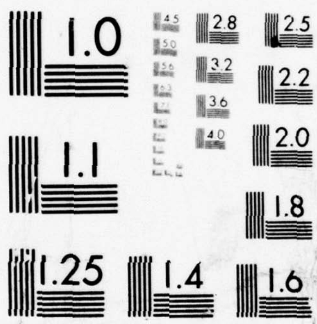

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AMMRC TR 79-17

AMMRC AUTOMATED STRESS-STRAIN DATA ANALYSIS, STORAGE, AND RETRIEVAL - PART 2: DATA BANK ENTRY AND RETRIEVAL PROCEDURES

April 1979

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ABSTRACT

As part of an in-house effort to improve physical standards and tolerances for materiel through the improvement of acceptance/rejection criteria we have developed a procedure for computer processing, storage, and retrieval of mechanical properties data. This second report of a three-part series describes a computer data bank of stress-strain data and the procedures used to access the data and to update the computer-stored data files. The data bank may be accessed through graphics or teletype remote terminals. User instructions for accessing the data are given, various selective retrieval options for the available material/alloy categories are presented, and various optional tabular listings from graphics and teletype terminals are also described. The retrieval program also includes an option for obtaining a graphical display of up to three stress-strain curves on the screen of a graphics terminal and a sample set of curves is shown. The simple updating procedures for the data bank are also described.

Procedures for reducing and analyzing the test data are given in AMMRC TR 79-16, which is Part 1 of the three-part series of reports. FORTRAN listings of all the computer programs used for data reduction, analysis, storage, and retrieval are given in AMMRC TR 79-18, which is Part 3.

CONTENTS

INTRODUCTION

A major objective of our developed computer procedure for processing, storage, and retrieval of mechanical properties data was to make the analyzed results of in-house tests readily available. The interest of the Engineering Standardization Division (ESD) in this joint program with Engineering Mechanics Division (EMD) was the use of the data in improving acceptance/rejection criteria as part of an in-house effort to improve standards and tolerances for materiel.

In a previous report[1] a system was described of computer-assisted data reduction and analysis for tension stress-strain test results. Test descriptors and test data for one test were automatically punched on a standard 80-column card by the EVALRO analysis program and a file of the punch cards then was assembled to become a hard-copy data bank. A file of card images was also established in the UNIVAC 1106 as a data bank to be accessible to all users of the computer. Each line entry in the computer file contains a coded set of material and test descriptors and the analyzed results of one tension stress-strain test.

No attempt was made to edit any of the data, hence the computer file (and the hard-copy punch card backup) should be considered to be an extended, generally accessible laboratory notebook. The entries for each tension test contain all the raw data except the autographically recorded stress-strain curve. For the latter, we have converted the analog output of the testing machine instrumentation to a set of digital values and analyzed the digitized data using the EVALRO computer program. The results of the analysis are calculated values of the elastic modulus, the 0.2% offset yield stress, and the Ramberg-Osgood exponent. These three calculated values are included in the entry for the test data and from them, a good approximation of the stress-strain curve to yield can be obtained.

It has been well established* that a variation of an equation, originally formulated by Ramberg and Osgood in the early 1940's, can be used to approximate the stress-strain curve from zero stress to somewhat past the yield region. The form of the equation is:

$$e = S/E + 0.002\ (S/S_y)^n \qquad (1)$$

where e and S are the strain and stress, E is the elastic modulus, S_y is the 0.2% offset yield stress, and n is the Ramberg-Osgood exponent. This equation is used to plot the stress-strain curve.

This report describes the form of the data in the computer files, the simplified data management schemes for data entry and retrieval, user instructions for data retrieval, and the various forms in which data can be retrieved from the computer. Complete FORTRAN listings of all the computer programs used for data reduction and analysis and for computer storage and retrieval are given in Reference 2.

*MIL-HDBK-5 recommends the use of the Ramberg-Osgood equation to approximate the stress-strain curve and is currently being revised to include Eq. 1 as the recommended form.

1. PAPIRNO, R. P. *AMMRC Automated Stress-Strain Data Analysis, Storage, and Retrieval - Part 1: Data Analysis Program.* Army Materials and Mechanics Research Center, AMMRC TR 79-16, April 1979.
2. PAPIRNO, R. P. *AMMRC Automated Stress-Strain Data Analysis, Storage, and Retrieval - Part 3: Computer Program Listings.* Army Materials and Mechanics Research Center, AMMRC TR 79-18, April 1979.

COMPUTER DATA STORAGE FILES

Two data files have been established in the UNIVAC 1106 computer. The test data are stored in a file which is catalogued under the name R*DATABANK. A second file was established to facilitate location of data for a specific material/alloy in the DATABANK file and this second file was catalogued under the name R*LOCATER. The location file also contains a count of the number of test data entries for each material/alloy in the data bank.

Materials and Data Identity

A simplified procedure is used to locate all entries for a specific material. The procedure is dependent upon a scheme for identifying materials using a two-part code. One part of the code refers to the basic material: steel, titanium, etc. The second part of the code refers to a specific alloy form of the material. Each part of the code contains two alphanumeric characters and a user of the retrieval program is automatically presented with code tables and instructions for their use at the computer terminal.

Each set of data for a single test has a serially assigned set number. No attempt was made to group the data before the set numbers were assigned. Rather, data sets for different materials have been intermixed and the set numbers were assigned in the chronological order in which the raw data were reduced. The data file in the computer can be considered as a numbered list of lines with the data for one test on each line. Data sets are entered into the file such that the set number corresponds to the line number.

Currently there are data for seven materials: steel, titanium, uranium, copper, tungsten, aluminum, and magnesium. The number of alloy forms for each varies since the current content reflects only tests which were done during a 15-month period. Shown in Figure 1 are the code designations for the seven materials and in Figure 2 are listings of the alloy forms available for each of the seven materials and the code designations which applies to each. The lists have been reproduced from computer printouts of the retrieval program. Note that the code ZZ is used when no specific alloy was identified for a given material. It should also be noted that the current computer file of test data is not considered to be a structural properties data base, but it is a compendium of analyzed results of individual stress-strain tests conducted by the Materials Properties Branch. The material/alloy categories were established by using the designations supplied by the principal investigators who ordered the tests and who, in most cases, supplied the test specimens or the specimen materials.

CODE TABLE FOR MATERIALS IN DATA BANK

MATERIAL	CODE	MATERIAL	CODE
STEEL	ST	TUNGSTEN	WF
TITANIUM	TI	ALUMINUM	AL
URANIUM	UR	MAGNESIUM	MG
COPPER	CU		

Figure 1. Code table of available materials reproduced from teletype output of retrieval program.

ALLOYS AND ALLOY CODES FOR STEEL

ALLOY NAME	CODE	ALLOY NAME	CODE
ARMOR UNSPEC	ZZ	RARE EARTH	1B
4340 UNSPEC	1A	ARMCO	2B
MARAGE-250	2A	HI NICKEL	3B
WC-9 ALLOY	3A	1340 UNSPEC	4B
4140 UNSPEC	4A	LOW MANGANESE	5B
GILD METAL	5A	HF-1 ALLOY	6B
4340 ESR	6A		
3% NICKEL	7A		
5% NICKEL	8A		
AF 1410	9A		

ALLOYS AND ALLOY CODES FOR TITANIUM

ALLOY NAME	CODE
6-6-2 ALLOY	1A
BASE SECTN	2A

ALLOYS AND ALLOY CODES FOR TUNGSTEN

ALLOY NAME	CODE
UNSPECIFIED	ZZ
PM UNSPEC	1A
SINTERED	2A
W-2 ALLOY	3A

ALLOYS AND ALLOY CODES FOR URANIUM

ALLOY NAME	CODE
DEPLETED	1A
.75-TI ALLOY	2A
UNALLOYED	3A

ALLOYS AND ALLOY CODES FOR ALUMINUM

ALLOY NAME	CODE
7075-T6	1A
WHISKER COMP	2A

ALLOYS AND ALLOY CODES FOR COPPER

ALLOY NAME	CODE
UNSPECIFIED	ZZ

NO OTHER COPPER DATA AVAILABLE

ALLOYS AND ALLOY CODES FOR MAGNESIUM

ALLOY NAME	CODE
AZ-61A	1A

Figure 2. Code tables of all available alloy designations reproduced from teletype output of retrieval program.

Retrieval Scheme for Computer-Stored Data

A locater number is assigned to each data set by the EVALRO analysis program and this number becomes part of the stored data of the test. The locater number is the set number of the just-prior-entry in the DATABANK file for a test of the same material/alloy. The locater number of the first set of data in the data file for each material/alloy category is zero. The set number of the last DATABANK entry for each material/alloy category is designated as the key set number. The key set numbers are maintained in a separate LOCATER file whose contents will subsequently be described.

The retrieval process can be illustrated with a specific example. Assume there are a total of six tests for a given material/alloy category and that the set numbers of these data are 3, 7, 11, 18, 19, and 81. The last entry for the category is Set 81, hence the number 81 is designated as the key set number and is stored in the LOCATER file. To retrieve all the data for the given category, the LOCATER file is entered and the key set number (81) is read. Then the DATABANK file is entered and all the data for set 81 are read. Included in the data is the locater number, which in this case is 19; this is the set number of the prior entry for the specified material/alloy category. Next the data for set 19 are read; for this set, the locater number is 18. The process would be repeated until the data for set 3 are read. Here the locater number would be zero indicating that no further data were entered in the DATABANK for the specified material/alloy category. This simple retrieval system was designed to avoid a more costly sorting process in which every entry in the DATABANK would be read in order to find entries for the selected material/alloy category and where sorting would be done using the material/alloy codes.

Content of the DATABANK File

Each line of the file contains the summarized data of a single stress-strain test. The line entry is a card image of one output card of the EVALRO analysis program as described in Reference 1. The individual data entries for each line and their columnar positions are given in Table 1 (taken from Reference 1). Note that the data and the test and material descriptors have been condensed and coded so that they occupy the first 72 columnar positions. The last eight positions containing the locater number and the set number (each occupying four columnar positions) are used in the retrieval process.

Table 1. EVALRO OUTPUT PUNCH CARD DATA

Column	Entry	Format
1-6	Specimen number	A6
7-8	Material code	A2
9-10	Alloy code	A2
11-14	MPB notebook number	A4
15-16	Notebook page	I2
17	Test type code	I1
18-23	Test date	I6
24-28	Test temperature, deg C	I5
29-30	Log of strain rate	I2
31-36	Ultimate strength, ksi	F6.1
37-40	Elongation, pct	F4.1
41-44	Reduction of area, pct	F4.1
45-48	Rockwell C hardness	F6.2
49-54	Elastic modulus, mega psi	F6.2
55-61	R-O exponent	F7.2
62-68	0.2% offset yield strength, ksi	F7.2
69-72	R-O standard error, ksi	F4.1
73-76	Locater number	I-4
77-80	Set number	I4

Content of the LOCATER File

The LOCATER file has two sections. Section 1 is contained in lines 1 through 7; each line is pertinent to one of the seven materials for which there are data

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available. The first two columns contain the alphanumeric material code (format A2). There are then 19 four-column groups in which are entered the key set numbers for each of the alloys of the given material. The first four-column group is for the code ZZ alloy in the list. The second group of four columns is for the code 1A alloy, etc. There are zero entries if no alloy has been assigned to a code designation. (See Figure 2 for alloy code designation.)

Section 2, occupying lines 31 through 37 of the LOCATER file, contains data for the number of tests. The columnar format is the same as in Section 1: the first two columns contain the material code followed by 19 four-column groups. The material code of line 30+J is the same as that of line J. Entered in each of the 19 four-column groups is the number of tests for the particular alloy code which is specific for that line position. The line positions of the alloys in Section 2 are the same as in Section 1.

Assuming that the line number J and the position number of each of the four-column groups is L, then referring to the code tables given Figure 1, we have assigned J=1 to steel; J=2 to titanium; J=3 to uranium; J=4 to copper; J=5 to tungsten; J=6 to aluminum; and J=7 to magnesium. The position numbers were assigned as follows: L=1 to the ZZ alloy; L=2 to L=10 to the 1A to 9A alloys; and L=11 to L=19 to the 1B to 9B alloys.

INTERACTIVE DATA RETRIEVAL PROGRAM

Data can be retrieved by all authorized users of the UNIVAC 1106 computer on Tektronix 4014 graphics terminals, on 132-character carriage-length standard teletype terminals, or on 80-character carriage-length portable teletype terminals. The retrieval program is catalogued in the computer under the file name R*RETRIEVE. The file contains two main programs: one for the graphics terminals and one for the teletype terminals. There are a number of subroutines in the program whose function will subsequently be described. Listings of the FORTRAN statements of each of the routines of the RETRIEVE file are given in Reference 2.

User Instructions

A potential user of the RETRIEVE programs need only be familiar with the basic operations of the demand terminal being used including the various keyboard operations, and be familiar with the standard procedures for accessing the UNIVAC 1106.

After the conventional RUN statement has been accepted by the computer, the user must enter @ASG,A R*RETRIEVE. and wait for a response from the computer. If no other individual is using the program, the word READY will appear at the terminal and data retrieval may be initiated. If the program is in use a message will appear to tell the user that the program is not available.

If the program is available, the user executes the program as follows:

1. On a graphics terminal enter: @ADD R*RETRIEVE.CRTUBE
2. On either teletype terminals enter: @ADD R*RETRIEVE.TELTYP

The first response of the computer will be the word READY appearing four times. This response indicates that the DATABANK and LOCATER files are available and have been automatically reserved for the user. The program then begins and the user is asked to make specific keyboard entries in response to instructions which appear at the terminal. When all the required data have been retrieved, instructions for terminating the program appear.

Data which are retrieved appear as tabular listings on the graphics and teletype terminals. As an option, stress-strain curves may be plotted on the screen of the graphics terminal.

Material and Alloy Choice

After initial terminal preparation instructions appear, the material code table shown in Figure 1 appears at the terminal. The user is asked to enter the selected material code. The appropriate alloy code table, from among those shown in Figure 2, would next appear at the terminal. The user is then asked to enter the selected alloy code. After the entry is made, a count of the total number of tests for the selected material/alloy appears at the terminal.

Selected Data Retrieval

Four options for data retrieval appear at the terminal:

1. All the data for the selected material/alloy.
2. Only data within a range of yield stress, to be specified.
3. Only data within a range of ultimate stress, to be specified.
4. Only data within a range of Rockwell C hardness, to be specified.

If the user selects to retrieve all the data, printout options as described subsequently are presented at the terminal. If only selected range data are desired, the user is asked to enter the parameter of interest. The computer responds by printing the minimum and maximum values of the parameter of the stored data. The user is then instructed to enter the desired minimum and maximum values of the parameter for the data to be retrieved. After the entry is made, the computer responds by printing the number of data sets whose value of the selected parameter lies within the selected range.

Data Printout

Users of graphics terminals or 132-character carriage-length teletype terminals are presented with two tabular printout options: a long form or a short form of the data. Users of the 80-character carriage-length portable terminals are given no choice; only an expanded short form printout is available. Each of the printouts is described below.

1. *Long Form.* A sample long form listing is shown in Figure 3, reproduced from a terminal printout in which all the data appear for aluminum alloy 7075-T6 (Code AL-1A). Note that all the test data in a line entry of the DATABANK, as previously shown in Table 1, appear in the listing. In addition, values of the 0.1% offset yield stress and proportional limit stress also appear. These have been calculated using the plastic strain term of Eq. 1 (see Reference 1) in the form:

$$e_p = 0.002\ (S/S_y)^n \tag{2}$$

where e_p is the plastic strain, S is the stress to be calculated, S_y is the 0.2% offset yield stress and n is the Ramberg-Osgood exponent. For calculating the proportional limit, it was assumed that the plastic strain had a value of 10 microinches per inch. This value is the least count of a Class B extensometer. Theoretically, the calculated proportional limit would be the value observed if an offset test had been performed on the specimen with a Class B extensometer installed.

2. *Short Form.* A sample short form listing is shown in Figure 4. The data appear in two side-by-side tables. The data missing from the short form are as follows: proportional limit and 0.1% offset yield stresses; specimen number, notebook reference, test date, standard error of estimate of Eq. 1, and test strain rate.

3. *Expanded Short Form.* This listing is the only one available to users of and 80-character carriage-length portable terminal and a sample is shown in Figure 5. The listing includes all the data of the short form and, in addition, the test strain rate and the proportional limit and 0.1% offset yield stresses.

On graphics terminals if more than 56 lines would be required for a full lising, only the first 56 lines are displayed. Then there is a pause in the program to allow the user to study (or copy) the data. The user is instructed to strike RETURN on the keyboard when ready to continue. The screen will then erase and the listing of additional data will appear on the screen. The user is also requested to make note of the set numbers of any data for which graphs of the stress-strain curve will be required.

LONG-FORM LIST OF DATA FOR MATL CODE: AL-1A

SET NO	TEMP DEG-C	LOG EDOT	MODULUS M-PSI	R-O EXPNT	P-LIM KSI	.1%-YLD KSI	.2%-YLD KSI	UTS KSI	SEE KSI	ELNG PCT	R-A PCT	ROCK C-HD	TEST DATE	NTBK-PAGE	SPEC NO
684	20	-4	9.88	28.07	56.34	66.39	68.05	76.8	.1	9.6	17.0	-1.0	81778	1A67-30	D1
683	20	-4	9.71	23.00	52.53	64.18	66.14	76.3	.2	10.2	16.2	-1.0	81778	1A67-30	C2
682	20	-4	9.90	21.14	51.56	64.10	66.24	76.8	.1	9.8	13.4	-1.0	81778	1A67-30	C1
681	20	-4	10.48	14.25	45.80	63.?7	66.42	70.7	.8	9.0	26.0	-1.0	81778	1A67-30	B2
680	20	-4	9.70	21.41	50.88	63.08	65.16	74.4	.3	7.6	21.8	-1.0	81778	1A67-30	B1
455	20	-4	10.06	16.85	44.66	58.70	61.16	74.6	.1	6.3	10.1	-1.0	31378	1A66-10	B
454	20	-4	10.31	16.49	45.34	59.95	62.52	75.7	.1	6.0	10.4	-1.0	31378	1A66-10	A
445	20	-4	11.29	14.95	43.95	59.80	62.64	76.5	.1	6.4	12.0	-1.0	30978	1A66- 6	7075-B
444	20	-4	11.25	16.23	44.72	59.39	61.98	76.4	.2	8.2	11.6	-1.0	30978	1A66- 6	7075-A
416	20	-4	11.52	17.85	51.38	66.50	69.13	80.0	.3	10.0	18.4	-1.0	21778	1A65-72	7075-B
415	20	-4	10.29	14.52	38.75	53.21	55.81	70.2	.1	7.5	11.0	-1.0	21778	1A65-72	7075-A

**LISTING IS COMPLETE FOR MATL AL-1A * TO CONTINUE THE PROGRAM KEY RETURN

Figure 3. Sample long form listing of data.

LISTING OF SHORT-FORM TEST DATA FOR MATL/ALLOY AL-1A

SET NO	TEMP DEG-C	EMOD M-PSI	.2%-SY KSI	UTS KSI	R-O EXPNT	ELNG PCT	R-A PCT	R-C HRD	SET NO	TEMP DEG-C	EMOD M-PSI	.2%-SY KSI	UTS KSI	R-O EXPNT	ELNG PCT	R-A PCT	R-C HRD
684	20	9.88	68.05	76.8	28.07	9.6	17.0	-1.0	683	20	9.71	66.14	76.3	23.00	10.2	16.2	-1.0
682	20	9.90	66.24	76.8	21.14	9.8	13.4	-1.0	681	20	10.48	66.42	70.7	14.25	9.0	26.0	-1.0
680	20	9.70	65.16	74.4	21.41	7.6	21.8	-1.0	455	20	10.06	61.16	74.6	16.85	6.3	10.1	-1.0
454	20	10.31	62.52	75.7	16.49	6.0	10.4	-1.0	445	20	11.29	62.64	76.5	14.95	6.4	12.0	-1.0
444	20	11.25	61.98	76.4	16.23	8.2	11.6	-1.0	416	20	11.52	69.13	80.0	17.85	10.0	18.4	-1.0
415	20	10.29	55.81	70.2	14.52	7.5	11.0	-1.0									

**LISTING IS COMPLETE FOR MATL AL-1A * TO CONTINUE THE PROGRAM KEY RETURN

Figure 4. Sample short form listing of data.

EXPANDED SHORT-FORM LIST OF DATA FOR MATL CODE: AL-1A
(FOR A FULL LONG-FORM LIST USE TELETYPE OR CRT TERMINAL)

SET NO	TEMP DG-C	LOG EDOT	EMOD M-PSI	R-O EXPNT	P-LIM KSI	.1%-YLD KSI	.2%-YLD KSI	UTS KSI	ELNG PCT	R-A PCT	ROCK C-HD
684	20	-4	9.88	28.07	56.34	66.39	68.05	76.8	9.6	17.0	-1.0
683	20	-4	9.71	23.00	52.53	64.18	66.14	76.3	10.2	16.2	-1.0
682	20	-4	9.90	21.14	51.56	64.10	66.24	76.8	9.8	13.4	-1.0
681	20	-4	10.48	14.25	45.80	63.27	66.42	70.7	9.0	26.0	-1.0
680	20	-4	9.70	21.41	50.88	63.08	65.16	74.4	7.6	21.8	-1.0
455	20	-4	10.06	16.85	44.66	58.70	61.16	74.6	6.3	10.1	-1.0
454	20	-4	10.31	16.49	45.34	59.95	62.52	75.7	6.0	10.4	-1.0
445	20	-4	11.29	14.95	43.95	59.80	62.64	76.5	6.4	12.0	-1.0
444	20	-4	11.25	16.23	44.72	59.39	61.98	76.4	8.2	11.6	-1.0
416	20	-4	11.52	17.85	51.38	66.50	69.13	80.0	10.0	18.4	-1.0
415	20	-4	10.29	14.52	38.75	53.21	55.81	70.2	7.5	11.0	-1.0

Figure 5. Sample expanded short form listing of data from an 80-character carriage terminal.

After a listing is completed, users of teletype terminals have the option of requesting additional listings or terminating the program. User of graphics terminals have an additional option to request a graph of up to three separate stress-strain curves on the cathode ray tube screen.

Stress-Strain Curves at Graphics Terminals

When the graph option is chosen, the user is first asked to enter whether 1, 2, or 3 curves are to be plotted. The next instruction asks for the set numbers of the data. The requested data are then plotted on the screen. One curve is drawn with a solid line, the second with a broken line, and the third with a dashed line. The proportional limit, 0.1% offset yield, and 0.2% offset yield strengths are marked on each curve. A caption below the graph identifies the material and alloy and gives the set numbers of the curves. A sample graph, copied from the screen, is shown in Figure 6.

After the graph is displayed, there is a pause in the program to allow the user to study and/or to make a hard copy of the curve. The program is continued when the user strikes the RETURN key of the terminal. The screen is erased and three options are presented: to plot additional graphs, to list additional data, or to terminate the program. Instructions for the appropriate keyboard entries are given on the screen.

Current Status and Future Plans

It is anticipated that by mid FY79, the computer data file will be up to date. At this time all tension tests from July 1977 will have been added to the file. Thereafter, we anticipate that the file will be updated on a monthly basis. In addition, data for tests performed prior to July 1977 will be reduced, analyzed, and added to the file.

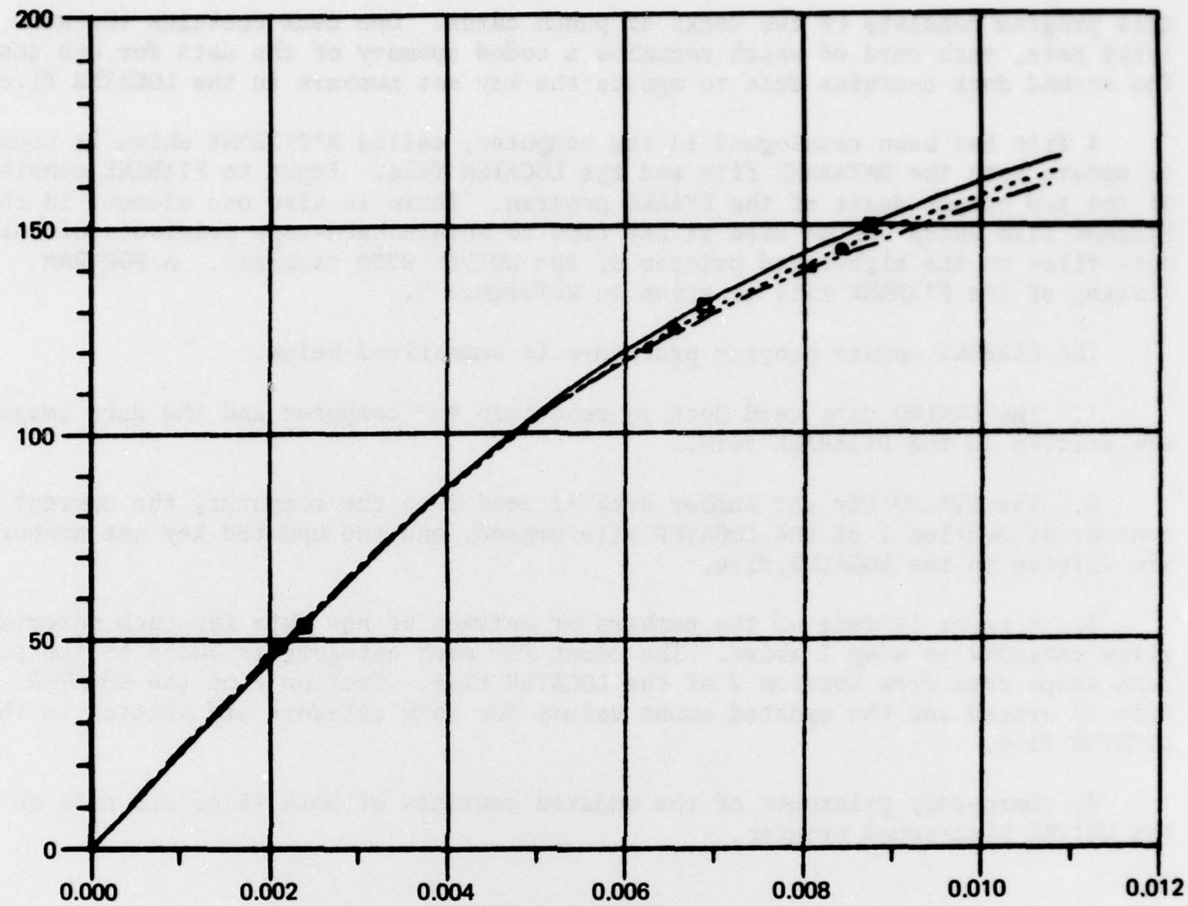

Figure 6. Sample graph of stress-strain data copied from the screen of a Tektronix 4014 graphics terminal.

There are also plans to establish a computer file of fracture toughness test results. In conjunction with this effort, we plan to develop a characterization scheme in which materials would be classified according to chemistry and thermomechanical treatment. When these efforts have been completed, it should be possible to retrieve toughness data on well-characterized materials. Future plans also include the reclassification of materials for which tensile data are now available and establishment of a new data file of tension tests which would contain data only for those materials whose complete processing history was available.

ENTRY OF DATA TO UPDATE FILES

Our current practice has been to add data to the computer file in batches of at least sixty test sets at one time. When a batch of reduced data is available, the analysis program EVALRO is performed (see Reference 1). The output of

this program consists of two decks of punch cards. One deck contains the analyzed data, each card of which contains a coded summary of the data for one test. The second deck contains data to update the key set numbers in the LOCATER file.

A file has been catalogued in the computer, called R*FIXBANK which is used to update both the DATABANK file and the LOCATER file. Input to FIXBANK consists of the two output decks of the EVALRO program. There is also one element in the FIXBANK file which can be used at any time to obtain hard-copy printouts of both data files on the high-speed printer of the UNIVAC 9300 terminal. A FORTRAN listing of the FIXBANK file is given in Reference 2.

The FIXBANK update program procedure is summarized below.

1. The EVALRO data card deck is read into the computer and the card images are written in the DATABANK file.

2. The EVALRO key set number deck is read into the computer, the current content of Section 1 of the LOCATER file erased, and the updated key set numbers are written in the LOCATER file.

3. A count is made of the numbers of entries of new data for each material/alloy category in step 1 above. The count for each category is added to the current value read from Section 2 of the LOCATER file. Section 2 of the LOCATER file is erased and the updated count values for each category are written in the LOCATER file.

4. Hard-copy printouts of the updated contents of both files are made on the UNIVAC high-speed printer.

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